

Claims

What is claimed is:

1. An aircraft propulsion system comprising:
a gas turbine engine comprising;
5 a fan section,
at least one row of FLADE fan blades disposed
radially outwardly of and drivingly connected to the
fan section,
the row of FLADE fan blades radially extending
10 across a FLADE duct circumscribing the fan section,
an engine inlet including a fan inlet to the fan
section and an annular FLADE inlet to the FLADE duct,
and
a fixed geometry inlet duct in direct flow
15 communication with the engine inlet.
2. A propulsion system as claimed in claim 1
wherein the fan section includes only a single
direction of rotation fan.
3. A propulsion system as claimed in claim 1
20 wherein the fan section includes axially spaced apart
first and second counter-rotatable fans and the FLADE
fan blades are drivingly connected to one of the
first and second counter-rotatable fans.
4. A propulsion system as claimed in claim 1
25 further comprising a row of variable first FLADE
vanes disposed axially forwardly of the row of FLADE
fan blades.
5. A propulsion system as claimed in claim 1
further comprising the row of FLADE fan blades

disposed between an axially forward row of variable first FLADE vanes and an axially aft row of second FLADE vanes.

5 6. A propulsion system as claimed in claim 4 wherein the fan section includes only a single direction of rotation fan.

10 7. A propulsion system as claimed in claim 4 wherein the fan section includes axially spaced apart first and second counter-rotatable fans and the FLADE fan blades are drivingly connected to one of the first and second counter-rotatable fans.

 8. A propulsion system as claimed in claim 1 further comprising:

15 a core engine located downstream and axially aft of the fan,

 a fan bypass duct located downstream and axially aft of the fan and circumscribing the core engine, and

20 the FLADE duct circumscribing the fan bypass duct.

 9. A propulsion system as claimed in claim 8 wherein the fan section includes only a single direction of rotation fan.

25 10. A propulsion system as claimed in claim 8 wherein the fan section includes axially spaced apart first and second counter-rotatable fans and the FLADE fan blades are drivingly connected to one of the first and second counter-rotatable fans.

11. A propulsion system as claimed in claim 8 further comprising a row of variable first FLADE vanes disposed axially forwardly of the row of FLADE fan blades.

5 12. A propulsion system as claimed in claim 8 further comprising the row of FLADE fan blades disposed between an axially forward row of variable first FLADE vanes and an axially aft row of second FLADE vanes.

10 13. A propulsion system as claimed in claim 12 wherein the fan section includes only a single direction of rotation fan.

14. A propulsion system as claimed in claim 11 wherein the fan section includes axially spaced apart
15 first and second counter-rotatable fans and the FLADE fan blades are drivingly connected to one of the first and second counter-rotatable fans.

15. A propulsion system as claimed in claim 14 further comprising:

20 the core engine having in serial flow relationship a row of core driven fan stator vanes, a core driven fan with at least one row of core driven fan blades, a high pressure compressor, a combustor, and a high pressure turbine drivingly connected to
25 the core driven fan,

the first and second counter-rotatable fans are radially disposed across an annular first fan duct,
first and second low pressure turbines drivingly connected to the first and second counter-rotatable
30 fans,

the core driven fan is radially disposed across

an annular second fan duct,

a vane shroud dividing the core driven fan stator vanes into radially inner and outer vane hub and tip sections,

5 a fan shroud dividing the core driven fan blades into radially inner and outer blade hub and tip sections,

10 a first bypass inlet to the fan bypass duct is disposed axially between the second counter-rotatable fan and the annular core engine inlet to the core engine,

15 a fan tip duct across the vane tip sections of the core driven fan stator vanes and across the blade tip sections of the core driven fan blades extending to a second bypass inlet to the fan bypass duct, and

a first varying means for independently varying a flow area of the vane tip section.

20 16. A propulsion system as claimed in claim 15 further a second varying means for independently varying a flow area of the vane hub section.

17. A propulsion system as claimed in claim 16 wherein the first and second varying means include independently varying vane tip sections and independently varying vane hub sections respectively.

25 18. A propulsion system as claimed in claim 17 further comprising a front variable area bypass injector door in the first bypass inlet.

19. A propulsion system as claimed in claim 15 further comprising:

30 the row of FLADE fan blades disposed radially outwardly of and drivingly connected to the second

counter-rotatable fan,

the high pressure turbine having a row of high pressure turbine nozzle stator vanes axially located between the combustor and a row of high pressure turbine blades of the high pressure turbine,

the row of high pressure turbine blades being counter-rotatable to the first low pressure turbine,

a row of variable low pressure stator vanes between first and second rows of low pressure turbine blades of the first and second low pressure turbines respectively, and

the row of high pressure turbine nozzle stator vanes, the row of high pressure turbine blades, the first row of low pressure turbine blades, the row of variable low pressure stator vanes, and the second row of low pressure turbine blades being in serial axial and downstream relationship.

20. A propulsion system as claimed in claim 15 further comprising:

the high pressure turbine having a row of high pressure turbine nozzle stator vanes axially located between the combustor and a row of high pressure turbine blades of the high pressure turbine,

the row of high pressure turbine blades being counter-rotatable to the first low pressure turbine,

a row of fixed stator vanes between the row of high pressure turbine blades and the first low pressure turbine,

no vanes between the first and second rows of low pressure turbine blades of the first and second low pressure turbines respectively, and

the row of high pressure turbine nozzle stator vanes, the row of high pressure turbine blades, the row of fixed stator vanes, the first row of low

pressure turbine blades, and the second row of low pressure turbine blades being in serial axial and downstream relationship.

21. A propulsion system as claimed in claim 15 further comprising:

the second counter-rotatable fan having axially spaced apart rows of first and second stage blades and a row of second stage fan vanes therebetween,

the row of FLADE fan blades disposed radially outwardly of and drivingly connected to the row of second stage blades,

the high pressure turbine having a row of high pressure turbine nozzle stator vanes axially located between the combustor and a row of high pressure turbine blades of the high pressure turbine,

the row of high pressure turbine blades being counter-rotatable to the first low pressure turbine,

a row of fixed stator vanes between the row of high pressure turbine blades and the first low pressure turbine,

no vanes between the first and second rows of low pressure turbine blades of the first and second low pressure turbines respectively, and

the row of high pressure turbine nozzle stator vanes, the row of high pressure turbine blades, the row of fixed stator vanes, the first row of low pressure turbine blades, and the second row of low pressure turbine blades being in serial axial and downstream relationship.

22. A propulsion system as claimed in claim 15 further comprising:

the second counter-rotatable fan having axially spaced apart rows of first and second stage blades

and a row of second stage fan vanes therebetween,
the row of FLADE fan blades disposed radially
outwardly of and drivingly connected to the row of
second stage blades,

5 the high pressure turbine having a row of high
pressure turbine nozzle stator vanes axially located
between the combustor and a row of high pressure
turbine blades of the high pressure turbine,

10 the row of high pressure turbine blades being
counter-rotatable to the first low pressure turbine,

a row of variable low pressure stator vanes
between first and second rows of low pressure turbine
blades of the first and second low pressure turbines
respectively, and

15 the row of high pressure turbine nozzle stator
vanes, the row of high pressure turbine blades, the
first row of low pressure turbine blades, the row of
variable low pressure stator vanes, and the second
20 row of low pressure turbine blades being in serial
axial and downstream relationship.

23. A propulsion system as claimed in claim 8
further comprising a single expansion ramp nozzle
downstream of and in fluid receiving communication
with the core engine and the fan bypass duct wherein
25 at least one internal cavity of the single expansion
ramp nozzle is in fluid cooling flow communication
with the FLADE duct.

24. A propulsion system as claimed in claim 23
wherein the fan section includes only a single
30 direction of rotation fan.

25. A propulsion system as claimed in claim 23
wherein the fan section includes axially spaced apart

first and second counter-rotatable fans and the FLADE fan blades are drivingly connected to one of the first and second counter-rotatable fans.

5 26. A propulsion system as claimed in claim 23 further comprising a row of variable first FLADE vanes disposed axially forwardly of the row of FLADE fan blades.

10 27. A propulsion system as claimed in claim 23 further comprising the row of FLADE fan blades disposed between an axially forward row of variable first FLADE vanes and an axially aft row of second FLADE vanes.

15 28. A propulsion system as claimed in claim 26 wherein the fan section includes only a single direction of rotation fan.

20 29. A propulsion system as claimed in claim 26 wherein the fan section includes axially spaced apart first and second counter-rotatable fans and the FLADE fan blades are drivingly connected to one of the first and second counter-rotatable fans.

30. A propulsion system as claimed in claim 23 further comprising:
25 a core engine located downstream and axially aft of the fan,
a fan bypass duct located downstream and axially aft of the fan and circumscribing the core engine, and
the FLADE duct circumscribing the fan bypass duct.

31. A propulsion system as claimed in claim 30 wherein the fan section includes only a single direction of rotation fan.

5 32. A propulsion system as claimed in claim 30 wherein the fan section includes axially spaced apart first and second counter-rotatable fans and the FLADE fan blades are drivingly connected to one of the first and second counter-rotatable fans.

10 33. A propulsion system as claimed in claim 30 further comprising a row of variable first FLADE vanes disposed axially forwardly of the row of FLADE fan blades.

15 34. A propulsion system as claimed in claim 30 further comprising the row of FLADE fan blades disposed between an axially forward row of variable first FLADE vanes and an axially aft row of second FLADE vanes.

20 35. A propulsion system as claimed in claim 34 wherein the fan section includes only a single direction of rotation fan.

25 36. A propulsion system as claimed in claim 33 wherein the fan section includes axially spaced apart first and second counter-rotatable fans and the FLADE fan blades are drivingly connected to one of the first and second counter-rotatable fans.

37. A propulsion system as claimed in claim 36 further comprising:
the core engine having in serial flow relationship a row of core driven fan stator vanes, a

core driven fan with at least one row of core driven fan blades, a high pressure compressor, a combustor, and a high pressure turbine drivingly connected to the core driven fan,

5 the first and second counter-rotatable fans and are radially disposed across an annular first fan duct,

 the core driven fan is radially disposed across an annular second fan duct,

10 a vane shroud dividing the core driven fan stator vanes into radially inner and outer vane hub and tip sections,

 a fan shroud dividing the core driven fan blades into radially inner and outer blade hub and tip sections,

15 a first bypass inlet to the fan bypass duct is disposed axially between the second counter-rotatable fan and the annular core engine inlet to the core engine,

20 a fan tip duct across the vane tip sections of the core driven fan stator vanes and across the blade tip sections of the core driven fan blades extending to a second bypass inlet to the fan bypass duct, and

25 a first varying means for independently varying a flow area of the vane tip section.

38. A propulsion system as claimed in claim 37 further a second varying means for independently varying a flow area of the vane hub section.

30 39. A propulsion system as claimed in claim 38 wherein the first and second varying means include independently varying vane tip sections and independently varying vane hub sections respectively.

40. A propulsion system as claimed in claim 39 further comprising a front variable area bypass injector door in the first bypass inlet.

5 41. A propulsion system as claimed in claim 1 further comprising the fixed geometry inlet duct having a two-dimensional convergent/divergent inlet duct passage with convergent and divergent sections, and a throat therebetween and a transition section
10 between the two-dimensional convergent/divergent inlet duct passage and the engine inlet.

42. A propulsion system as claimed in claim 41 wherein the fan section includes only a single direction of rotation fan.

15 43. A propulsion system as claimed in claim 41 wherein the fan section includes axially spaced apart first and second counter-rotatable fans and the FLADE fan blades are drivingly connected to one of the first and second counter-rotatable fans.

20 44. A propulsion system as claimed in claim 41 further comprising a row of variable first FLADE vanes disposed axially forwardly of the row of FLADE fan blades.

25 45. A propulsion system as claimed in claim 41 further comprising the row of FLADE fan blades disposed between an axially forward row of variable first FLADE vanes and an axially aft row of second FLADE vanes.

46. A propulsion system as claimed in claim 44 wherein the fan section includes only a single

direction of rotation fan.

47. A propulsion system as claimed in claim 44 wherein the fan section includes axially spaced apart first and second counter-rotatable fans and the FLADE fan blades are drivingly connected to one of the first and second counter-rotatable fans.

48. An aircraft comprising:

a gas turbine engine within a fuselage of the aircraft,

the gas turbine engine comprising;

a fan section,

at least one row of FLADE fan blades disposed radially outwardly of and drivingly connected to the fan section,

the row of FLADE fan blades radially extending across a FLADE duct circumscribing the fan section, and

an engine inlet including a fan inlet to the fan section and an annular FLADE inlet to the FLADE duct; and

a fixed geometry inlet duct extending between an air intake mounted flush with respect to the fuselage and the engine inlet.

49. An aircraft as claimed in claim 48 wherein the fan section includes only a single direction of rotation fan.

50. An aircraft as claimed in claim 48 wherein the fan section includes axially spaced apart first and second counter-rotatable fans and the FLADE fan blades are drivingly connected to one of the first and second counter-rotatable fans.

51. An aircraft as claimed in claim 48 further comprising a row of variable first FLADE vanes disposed axially forwardly of the row of FLADE fan blades.

5 52. An aircraft as claimed in claim 48 further comprising the row of FLADE fan blades disposed between an axially forward row of variable first FLADE vanes and an axially aft row of second FLADE vanes.

10 53. An aircraft as claimed in claim 51 wherein the fan section includes only a single direction of rotation fan.

15 54. An aircraft as claimed in claim 51 wherein the fan section includes axially spaced apart first and second counter-rotatable fans and the FLADE fan blades are drivingly connected to one of the first and second counter-rotatable fans.

55. An aircraft as claimed in claim 48 further comprising:

20 a core engine located downstream and axially aft of the fan,

a fan bypass duct located downstream and axially aft of the fan and circumscribing the core engine, and

25 the FLADE duct circumscribing the fan bypass duct.

56. An aircraft as claimed in claim 55 wherein the fan section includes only a single direction of rotation fan.

57. An aircraft as claimed in claim 55 wherein the fan section includes axially spaced apart first and second counter-rotatable fans and the FLADE fan blades are drivingly connected to one of the first and second counter-rotatable fans.

58. An aircraft as claimed in claim 55 further comprising a row of variable first FLADE vanes disposed axially forwardly of the row of FLADE fan blades.

59. An aircraft as claimed in claim 55 further comprising the row of FLADE fan blades disposed between an axially forward row of variable first FLADE vanes and an axially aft row of second FLADE vanes.

60. An aircraft as claimed in claim 59 wherein the fan section includes only a single direction of rotation fan.

61. An aircraft as claimed in claim 48 further comprising the fixed geometry inlet duct having a two-dimensional convergent/divergent inlet duct passage with convergent and divergent sections, and a throat therebetween and a transition section between the two-dimensional convergent/divergent inlet duct passage and the engine inlet.

62. An aircraft as claimed in claim 61 wherein the fan section includes only a single direction of rotation fan.

63. An aircraft as claimed in claim 61 wherein the fan section includes axially spaced apart first and

second counter-rotatable fans and the FLADE fan blades are drivingly connected to one of the first and second counter-rotatable fans.

5 64. An aircraft as claimed in claim 61 further comprising a row of variable first FLADE vanes disposed axially forwardly of the row of FLADE fan blades.

10 65. An aircraft as claimed in claim 61 further comprising the row of FLADE fan blades disposed between an axially forward row of variable first FLADE vanes and an axially aft row of second FLADE vanes.

15 66. An aircraft as claimed in claim 64 wherein the fan section includes only a single direction of rotation fan.

20 67. An aircraft as claimed in claim 64 wherein the fan section includes axially spaced apart first and second counter-rotatable fans and the FLADE fan blades are drivingly connected to one of the first and second counter-rotatable fans.

68. An aircraft as claimed in claim 48 further comprising:

a variable throat area engine nozzle downstream and axially aft of the core engine,

25 cooling apertures in the centerbody and in a wall of the engine nozzle in fluid communication with the FLADE duct, and

afterburners aft and downstream of the low pressure turbine section.